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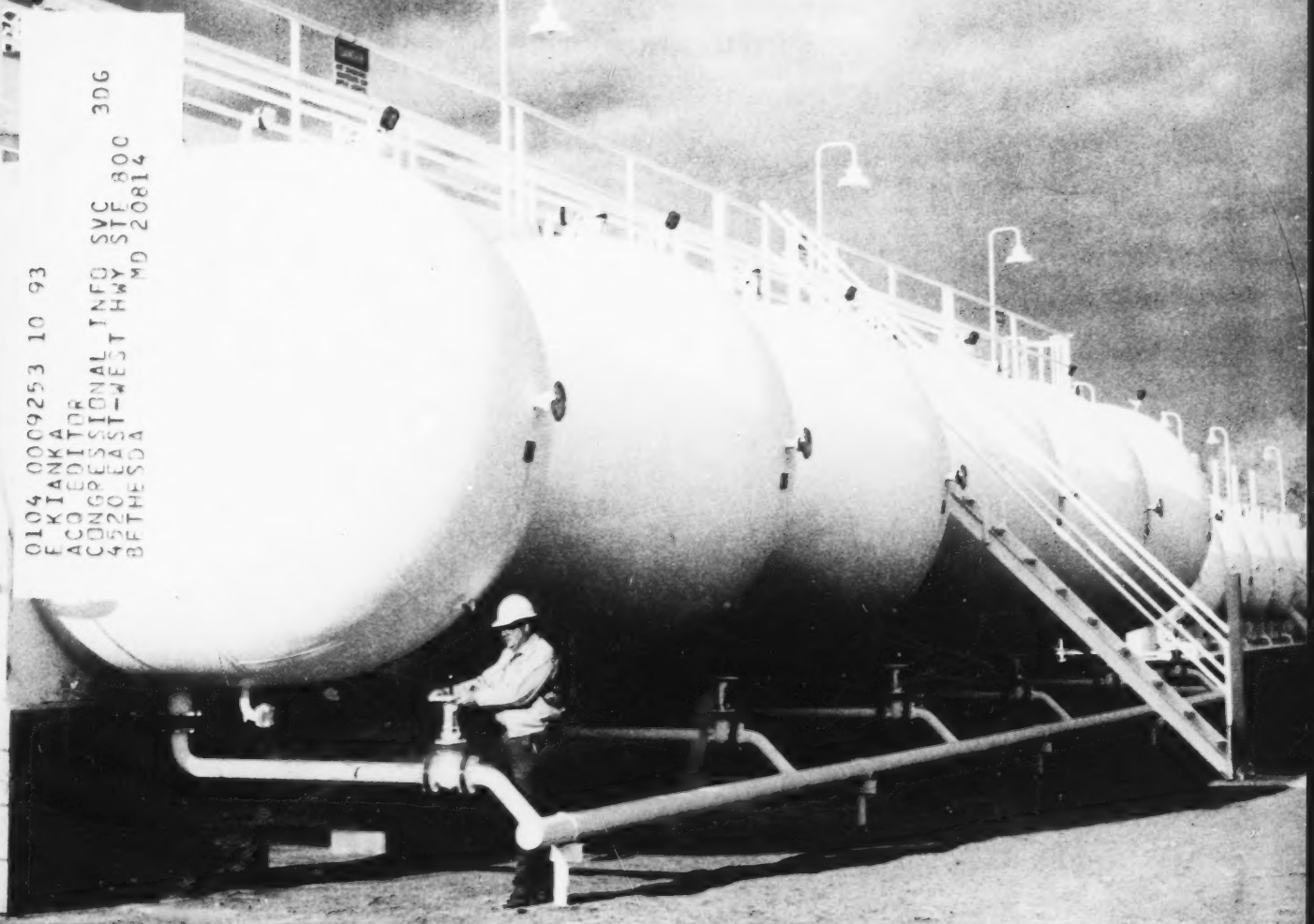

Peakshaving Forecast Report
Infrastructure Renewal
Construction-Equipment Survey

PIPELINE & GAS JOURNAL

International Pipeline & Gas Utility Design, Construction & Operation

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Infrastructure Renewal: Disaster Or Opportunity For Gas Utilities? 18

Emphasis on renewal of the nation's infrastructure—water lines, sewer lines, highways, roads, bridges—will have major impact on gas utilities, whose mains and services will be disturbed, and the renewal programs will have great impact on gas distribution budgets, operations, construction and maintenance programs; a distinguished panel of 10 leading gas men discuss the problems and opportunities.

Record Peakshaving Capacity Ready For 1983-84 Winter Season 28

Distribution industry planning for cold winter, fine-tuning programs to provide for heavy demands; continuing decline in demand, suggestions of mild weather make planning a puzzle.

DistriGas: Success Story Of A Unique LNG Operation 40

The only successful LNG import operation in the U.S. is tailored toward supplying New England area gas utility company customers with either liquid—delivered by truck—or as a vaporized gas into the region's gas system.

Equipment Needs, Uses Vary With Gas, Liquids Pipelines 44

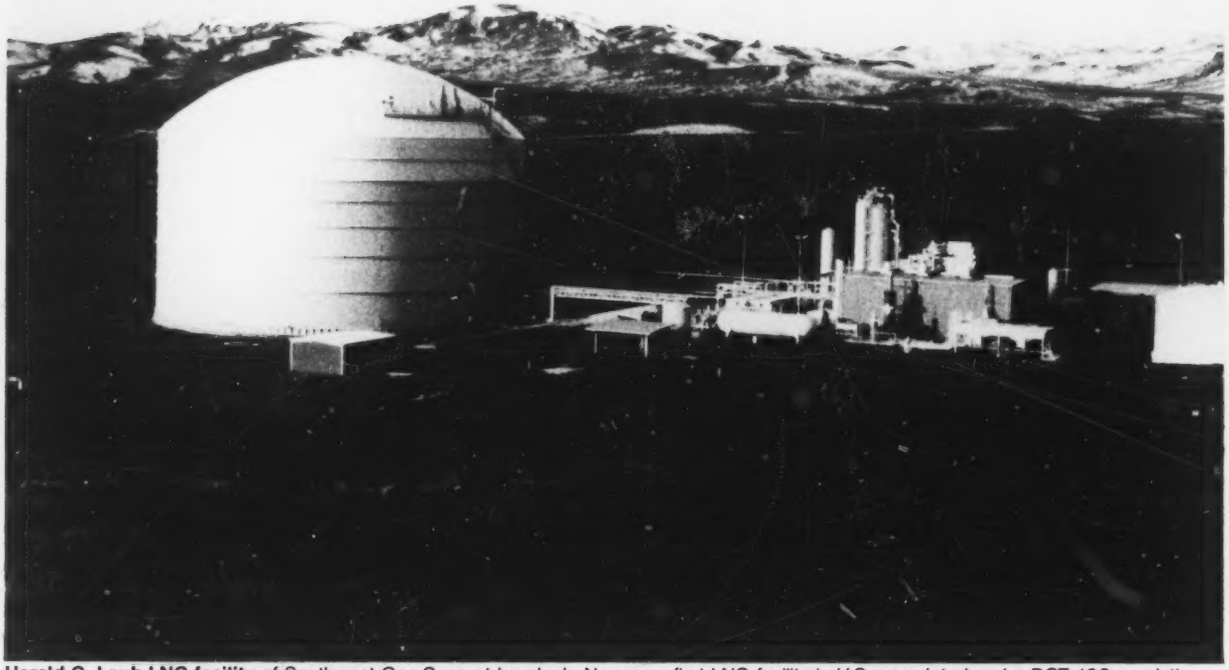
Cross-country oil, gas, and products pipelines do relatively little of their mainline construction, about one-third of the gathering lines installed, and require specialized equipment for maintenance of pipelines and stations.

COVER

Propane-air plants supply only 7% of the peakshaving gas supplies but are very important because they generally serve towns and areas remote from other sources.

—photo courtesy Southern Union Gas Co.

Peakshaving Forecast and Report



Harold G. Laub LNG facility of Southwest Gas Corp. at Lovelock, Nev., was first LNG facility in U.S. completed under DOT 193 regulations; the 290,000 bbl storage tank is dominant feature of the plant that has liquefaction rate of 5 MMcf per day and vaporization rate of 105 MMcf per day, delivered at 900 psi and 60 F to the pipeline.

Capacity Increases Slightly, Industry Ready For Winter

by Dean Hale, *Editor*

Peak day demands on the nation's gas distribution system during the coldest day or days of the 1983-1984 winter will be anyone's guess, as the industry prepares for another unusual and frustrating time when overall customer gas usage is down and the variables of temperature and customer reaction are completely unpredictable.

The major problem, as pointed out to PIPELINE & GAS JOURNAL during its latest annual peaksaving survey, is that customers have been practicing conservation with determination—and that is reflected in overall lower gas sales for over a year now. But, when it really gets cold, conservation flies out the window and the demands on gas systems skyrocket. Blizzards, blue northerns, and extended cold spells can put great stress and strain on the best-made plans of gas men. Peakshaving supplies generally are more than ample, but there may be instances where some classes of customers will have to be interrupted by some utilities—assuming that it does get that cold.

Meteorologists generally are forecasting a cold winter during the 1983-1984 season, but not one that is bitterly cold over an extended period. Regardless, with nearly 41 million gas customers heating their homes with natural gas, pipelines are expected to be operating at capacity and most of the nation's peakshaving facilities will be operating at some time, supplying supplemental gas to back up contract supply sources.

P&GJ's latest peakshaving survey indicates that a capacity of 75.13 billion cu ft maximum delivery for one 24-hr period, using gas from all available peakshaving gas sources, could be available if needed. To that could be added an estimated 67.6 Bcf of regularly scheduled deliveries per day to produce a projected maximum delivery in one day that could reach 142.73 Bcf. Because the entire nation seldom experiences a major, nationwide cold spell simultaneously in all 48 continguous states, it is doubtful that such a peak delivery could be attained.

A maximum total delivery of 76 to 86 Bcf in a single 24-hour period is projected for the 1983-1984 winter period for the gas industry. Supplemental gas supplies from LNG peakshaving plants, propane-air plants, and underground gas storage, as well as from other sources such as line pack, gas holders, SNG plants, etc., will provide a substantial portion of the gas demand at any specific time during the winter seasons in areas such as the northeastern and north central states, where extended periods of really cold weather have been known to prevail.

For the 1983-1984 winter season,

peakshaving supplies will include:

60.48 Bcf from underground gas storage
5.30 Bcf from propane-air plants
9.10 from LNG peakshaving and satellite plants
0.25 Bcf from other sources

The small increase in deliverability for the 1983-1984 marks the second year that the gas industry has reported only minimal gains in peakshaving capabilities after 14 straight years of substantial increases. Increases in underground gas storage capacities, resulting from new and expanded facilities, are offset by abandonment of older, less economical facilities. Only limited LNG peakshaving facilities increases are underway at this time, although interest in additional new facilities remains high. Additions to propane-air plants or new propane-air plant facilities were nominal during the year, mostly in improvements to existing plants and additional tank storage. "Other" sources that continue to be used include SNG plants (operated only if necessary because of the high cost of their feedstocks—naphtha, kerosine, other hydrocarbons), plus line pack, gas holders, some buried bottle-type storage, and enrichment of gas stream by direct injection of propane or ethane to boost the Btu content of the gas stream.

Underground Gas Storage

The search for new underground gas storage containers—aquifers, salt domes, abandoned oil and gas fields, and tight caverns—is being continued by gas pipelines and gas distribution companies. The need for such storage is obvious—for every two Mcf of new daily demand that is sold or created, aother Mcf of peakshaving capacity must be provided. The actual range is from 0.2 to 0.8 Mcf for each Mcf unit of demand, because every company is different, with the average at 0.5 Mcf.

During 1983, the gas industry spent $198 million for storage facilities—drilling and completing injection and withdrawal wells, observation wells, installation of new field lines, installation of new compressor horsepower, and installation of related measurement, dehydrating, filtering, and odorization equipment and control systems and communications systems.

As of November 1, 1983, there were 409 underground gas storage fields being operated or developed by 104 companies, including 398 fields considered active, another 11 under development. Maximum deliverability of the 398 fields is estimated at 60.48 Bcf per day in a 24-hr period.

At the 409 operating and underdevelopment gas storage fields, there are 18,536 wells (a net increase of 222 over 1982), 7162 miles of field lines (up 152 miles), and a net gain of 13 compressor stations (net total of 298) with a net increase of 30,430 hp for the year; net total of 1,720,554 hp.

Preliminary data for 1984 indicates that 135 new wells will be drilled, over 330 will be worked over, 96 miles of new field lines are planned, and over 15,000 hp will be added. Projections do not include requirements of projects not yet publicly announced.

Current gas storage developments include:

Battle Creek Gas Co. is developing the Lee 2 field in Calhoun County, Mich., which is expected to have an estimated working capacity of 750 MMcf.

Michigan Gas Utilities Co. is planning to develop the Campbell Field, in Calhoun County, Mich., for storage service. It will have an estimated capacity of 300 MMcf.

Consolidated Gas Supply Corp. is continuing reconditioning work (cost: $1 million) in 1984 on its Lost Creek Storage Field in Lewis and Harrison Counties, West Va.

B.C. Hydro and Power, Vancouver, British Columbia, has signed agreement with **Washington Water Power Co.** of Spokane to use part of the latter's share of the Jackson Prairie storage facility near Chehalis, Wash. B.C. Hydro will store up to 2.824 billion cu ft in the summer and, by exchange, receive the gas back in the winter. Agreement is for five years—through April 30, 1988.

(Continued)

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Propane-Air Plants

Propane-air plant changes were insignificant during 1983. One new plant was installed, bringing the total to 505 propane-air plants now operated by 242 gas utilities in 41 states. Several plant revisions were reported, and total deliverability increased slightly to 5.3 billion cu ft per day total. An estimated 4 million gal. of additional propane storage was added at both new and existing propane-air plants during 1983.

LNG Peakshaving Developments

New Jersey Natural Gas Co. has received necessary state and local approvals to expand its satellite facility in Howell Township. Construction of the 117,000-bbl capacity storage tank and addition of the 60 MMcf per day submerged combustion vaporizer is ongoing. Excavation for the tank foundation began in August. The added capacity should be onstream by late 1984. The New Jersey Board of Public Utilities required that the addition comply with the Department of Transportation's Material Transportation Bureau (MTB) Safety Standards contained in the Code of Federal Regulations Title 49, Part 193. PDM is the prime contractor for both the systems and the suspended deck storage tank.

North Carolina Natural Gas Corp. has temporarily postponed its plans to construct an LNG peakshaving plant. Conservation and loss of industrial gas loads were cited as reasons behind the decision.

Energy Terminal Services (ETS) continues to process its application to convert its Staten Island Terminal site into a peakshaving facility. The present holdup in the approval process is related to compliance with MTB's safety standards involving the adequacy of flammable vapor-gas dispersion exclusion zone. FERC has required compliance with MTB's safety standards as part of its Section 7 approvals under the Natural Gas Act.

In Europe, activities remain slow in the area of LNG peakshaving. Peakshaving requirements, however, are expected to increase substantially. In terms of cost, Nederlandse Gasunie forecasts that peakshaving will increase from its present 4% of the consumer price to 11% in the 1990's. The same report spoke of a doubling of underground storage requirements. The increased need for peakshaving capacity is attributed to a steady shift towards residential/commercial sales and away from industrial. The decline in industrial sales was reflected in Ruhrgas' 1982 annual report.

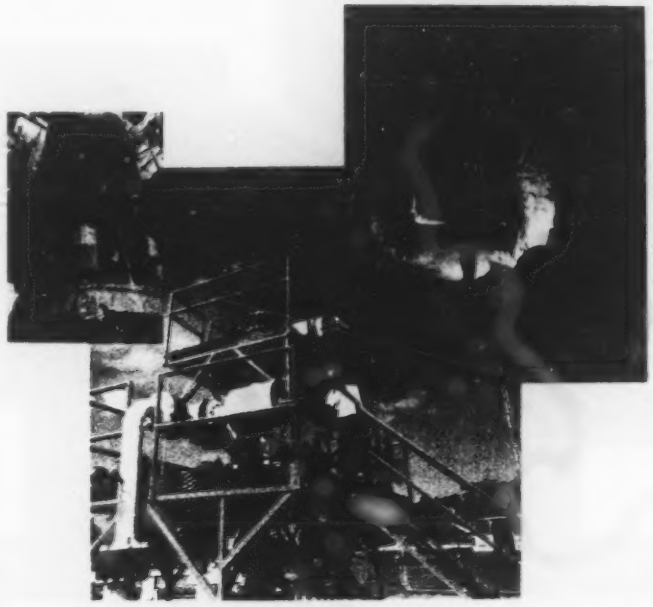
Base-Load LNG Developments

In the past year, two new LNG projects have been implemented: Malaysia-Japan and Indonesia-Japan (expansion). In addition, Indonesia and Korea have agreed to implement a project beginning in 1986-1987.

The initial cargo of LNG in the Malaysia-Japan project was loaded at the Bintulu, Sarawak LNG Plant on January 29 aboard the *Tenega Satu.* She sailed on January 30. The cargo was delivered to the Sodegaura terminal in Japan on February 7.

Final negotiations involving pricing for the LNG were reportedly concluded between exporter and importers earlier in January. Terms have not been disclosed but are believed to call for c.i.f. price that is close to but slightly above those currently in effect for Indonesia, Brunei, and Alaska, which now average approximately $4.90/MM Btu c.i.f.

The LNG exporter is Malaysian LNG Sdn Bhd, owned 6.5% by Petronas—the Malaysian state petroleum company, and 17.5% each by Shell Gas B.V. and Mitsubishi Corp. The LNG buyers are Tokyo Electric Power Co. Inc. (TEPCO) and Tokyo Gas Co., Ltd. TEPCO will take approximately 4 million tons per year (580 MM CF/d) and Tokyo Gas approximately 2 million tons per year (290 MM CF/d) at plateau volumes over the 20 year contract. Deliveries in 1983 are scheduled to be approximately 1.7 million tons (246.5 MM CF/d). That will increase to 3 million tons (435 MM CF/d) in 1984 and 4.5 million tons (652.5 MM CF/d) in 1985. Tokyo Gas and TEPCO are also constructing a new terminal at Higashi-



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U.S. Underground Gas Storage Operations—Operating Companies—1983 Data

Company	No. of Fields	No. of Wells	Miles Storage Lines	Storage Compressor Stations No.	Storage Compressor Stations HP
ANR Storage Co.	4	40	21.80	3	26,250
Arco Aluminum Co.	1	N/A	N/A	N/A	N/A
Arkansas Louisiana Gas Co.	5	80	43.10	3	40,500
Arkansas Oklahoma Gas Co.	1	12	3.00	1	370
Arkansas Western Gas Co.	4	12	3.72	4	2,355
Battle Creek Gas Co.	3	3	2.00	2	1,050
		—(1 under development)—			
Bear Creek Storage Co.	1	68	25.00	1	28,000
Brady, Tex., Municipal Gas Corp.	1	2	2.00	1	420
Cabot Corp.	2	14	14.60	2	2,020
Central Illinois Light Co.	2	81	21.27	2	4,000
Central Illinois Public Service	3	78	9.80	3	3,220
		—(1 under development)—			
Citizens Gas & Coke Utility	8	182	319.00	2	3,695
Colorado Interstate Gas Co.	4	122	230.00	3	9,700
Columbia Gas Transmission Corp.	49	3,725	1,221.50	27	108,925
Columbia Gas of Pennsylvania	1	8	3.43	1	900
Consolidated Gas Supply Owned	9	1,054	458.00	9	119,300
Joint	4	296	117.00	8	60,390
	13	1,350	575.00	17	179,690
Consumers Power Co.	11	477	128.66	4	79,310
Delhi Gas Pipeline Corp.		—(1 under development)—			
Delta Natural Gas Co.	1	2	2.00	1	360
Dow Chemical Co.	1	N/A	N/A	N/A	N/A
East Ohio Natural Gas Co.	4	759	258.20	3	20,220
El Paso Natural Gas Co.	2	59	57.00	2	13,400
Elizabethtown Natural Gas Co.	1	2	2.00	1	300
Egyptian Gas Storage Co.	2	3	—	—	—
Equitable Gas Co.	15	284	126.40	8	14,910
Exxon Corp.	1	N/A	N/A	N/A	N/A
Felmont Oil Corp.	1	10	6.00	1	1,050
Gas Utilities (Ill.)	1	4	3.10	—	—
Hampshire Gas Co.	1	13	17.00	1	1,640
Honeoye Storage Corp.	1	38	16.90	1	2,750
Hoosier Gas Corp.	3	24	8.30	0	—
Houston Pipe Line Co.	1	59	12.00	5	23,010
Illinois Power Co.	8	236	34.75	8	12,100
Indiana Gas Co.	7	290	106.08	4	2,770
Kane Gas Light & Heat Co.	1	14	10.00	1	60
K N Energy, Inc.	4	35	20.90	3	5,530
Laclede Gas Co.	1	50	32.08	1	9,020
Llano, Inc.	1	5	4.00	2	2,000
Lone Star Gas Co.	11	109	78.04	9	24,770
Louisville Gas & Electric Co.	9	837	126.16	3	19,055
Michigan Consolidated Gas Co.	5	523	90.00	4	71,000
Michigan Gas Storage	3	554	166.10	1	30,900
Michigan Gas Utilities Co.	4	8	4.00	6	3,200
Michigan Wisconsin Pipe Line Co.	15	1,254	316.00	10	110,700
		—(1 under development)—			
Mid Louisiana Gas Co.	1	5	N/A	1	2,200
Midwestern Gas Transmission Co.	2	40	10.46	1	1,320
Minnegasco	1	40	15.00	1	2,200
		—(1 under development)—			
Mississippi River Transmission Corp.	3	66	72.06	3	22,050
Mississippi Valley Gas Co.	1	3	1.00	1	584
Montana-Dakota Utilities Co.	3	87	103.00	3	22,422
Montana Power Co.	4	39	38.00	3	5,960
Mountain Fuel Resources, Inc.	1	44	21.76	1	13,000
Mountain Fuel Supply Co.	3	26	10.00	3	6,000
Mustang Fuel Corp.	1	1	4.00	—	—
National Fuel Gas Supply Corp.					
owned	26	909	486.80	15	25,825
National Fuel Gas Supply Corp. joint	4	379	63.10	(4)	(39,900)
Total	30	1,288	549.90	15	25,825
		—(3 under development)—			
National Gas & Oil Corp.	3	31	8.00	3	1,950
National Zinc Co.	1	7	—	1	119
Natural Gas Pipeline Co. of America	13	860	301.70	8	119,040
North Penn Gas Co. owned	2	18	12.62	1	4,995
(joint	1)				
Northern Gas Co.	3	7	8.00	3	2,043
Northern Illinois Gas Co.	7	505	264.03	6	113,990
Northern Indiana Public Service	2	145	29.00	2	7,320
Northern Natural Gas Co.	3	314	218.35	2	21,160
Northwest Central Pipeline Corp.	10	589	164.00	6	29,800
Oklahoma Natural Gas Co.	4	60	22.00	2	11,200
Old Ocean Fuel Co.	1	21	5.00	1	3,130
Pacific Gas & Electric Co.	3	94	22.47	3	14,990
Panhandle Eastern Pipe Line Co.	5	241	114.00	5	19,350
Penn York Energy Co.	1	N/A	N/A	N/A	N/A
Peoples Gas Light & Coke Co., The	1	138	189.50	1	14,900
Peoples Natural Gas Co.	7	72	38.10	7	12,520
T.W. Phillips Gas & Oil Co.	8	74	N/A	8	2,400
Phillips Petroleum Co.	3	6	22.00	2	620
Pioneer Corp.	1	9	3.00	1	4,928
		—(1 under development)—			
Public Service Co. of Colorado	1	13	8.27	1	17,000
Rocky Mountain Natural Gas Co.	1	7	18.00	1	1,000
Sherwin Williams Co.	1	N/A	N/A	N/A	N/A
South Louisiana Production Co.	1	3	10.00	1	30
Southeastern Michigan Gas Co.	3	8	2.00	3	3,920
Southern Indiana Gas & Electric Co.	2	83	17.30	2	1,500
Southern Natural Gas Co.	1	73	48.22	1	21,750
Southern California Gas Co. & Pacific Lighting Gas Supply Co.	6	325	124.28	6	104,090
Southern Union Co. (Gas Co. of New Mex.)	1	12	12.00	2	1,525
Southwest Gas Corp.	1	—(1 under development)—			
Southwest Gas Storage Co.	1	55	21.00	1	15,000
Southwestern Gas Pipeline Inc.	2	11	3.45	1	440
Tennessee Gas Pipeline Co. (joint)	5	406	2.00	2	19,600
Texas Eastern Transmission Corp. owned	1	75	33.20	1	11,000
Texas Gas Transmission Corp.	10	457	217.26	11	19,765
Texas Utilities Fuel Co.	1	43	15.00	1	3,600
Transcontinental Gas Pipe Line Corp. owned	3	57	22.45	3	46,100
(joint	2	181	79.00	1	34,300)
Transok Pipe Line Co.	1	29	10.00	1	4,500
Trunkline Gas Co.	1	86	27.00	1	7,400
Union Gas System, Inc.	4	94	19.80	1	165
United Gas Pipe Line owned	1	19	6.10	1	2,500
joint	1	73	21.70	1	34,000
Total	2	92	27.80	2	36,550
Valero Gas Storage Co.	1	4	1.00	1	8,000
		—(under development)—			
Victor Gas Co.	1	6	12.00	2	300
Washington Natural Gas joint Washington Water Power Co. Northwest Pipeline Co.	1	77	9.90	1	12,500
Western Kentucky Gas Co.	6	60	20.30	4	1,555
Western Slope Gas Co.	3	37	27.34	2	3,368

Ogishima, Kawasaki to receive Malaysian LNG.

The other four Malaysian LNG tankers that will service the trade are still reportedly in layup in Norway awaiting their scheduled entry into the trade. The first train of the three-train plant has reportedly had no significant problems coming on stream. It is understood that the other two trains are nearly mechanically complete. It is reasonable to expect that the second train would be brought on stream around mid-year and the third about year's end.

The first lifting from the P.T. Badak plant under the expansion contract was made on August 25. The lifting made by the *Bishu Maru,* which underwent its gas trials in Japan prior to sailing for Bontang Bay. The event marked the first lifting of an LNG cargo by a Japanese flag vessel. An as yet unspecified number of cargoes are to be lifted this year under the 1981 contract from Trains C and D at the Badak plant.

The start-up and first month's operation of Train C is understood to have been remarkably smooth. By early August, production capacity had reportedly reached 135% of design. In September, Train D started producing LNG into storage and was expected to be at full capacity in October. The amount of LNG produced from Trains C and D over and above contract commitments is expected to be used to replace lost production from Train B. Train B at the P.T. Badak plant was severely damaged in an accident on April 14.

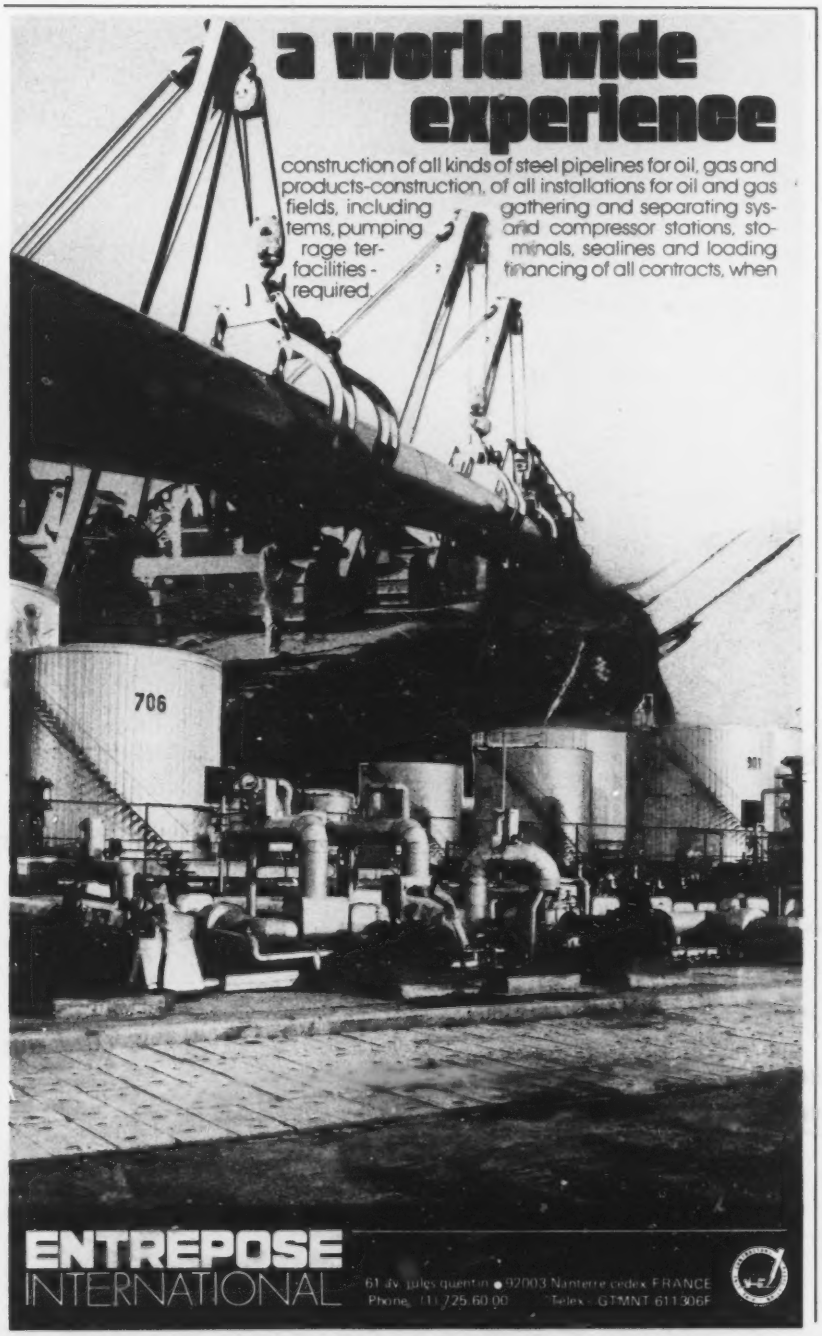
On August 12, General Joedo Sumbono, President-Director of Pertamina, and Park Jung-Ki, President of Korea Electric Power Corp. (Kepco), signed the long awaited gas supply contract. Under the contract, Pertamina will sell Kepco approximately 2 million tons of LNG annually (290 MM CF/d) for a period of 20 years beginning in late 1986 or early 1987. The LNG will come from a sixth train to be constructed at the P.T. Arun LNG plant at Blang Lancang, North Sumatra. It will be delivered to a terminal to be constructed by Kepco near Pyontack on Asan Man Bay. Shipping arrangements for the gas, which is to be sold on a c.i.f. basis, will be by chartering of existing hulls. Regarding pricing provisions, as with other Indonesian contracts, the base price will be linked to the average export price of Indonesian crude oils. Based upon the quantity of LNG and the value of the contract as stated at the signing ceremonies, the current c.i.f. price Korea should be approximately $5.12/million Btu.

The plant expansion involving the construction of the sixth train is expected to cost $400 million according the press reports. The main cryogenic exchanger for the train was moved to the P.T. Badak plant where it was being installed in place of the exchanger destroyed in the April 14 accident. When the replacement exchanger for P.T. Badak's Train B is received in mid-1984 from Air Products and Chemicals, Inc., the Arun exchanger will be removed and returned for installation in Train 6. Contracts for this phase of the P.T. Arun expansion have not been awarded. It would appear reasonable to expect that Chyoda Chemical Engineering and Construction Company, Ltd., would receive the contract. It is the general contractor for the current plant expansion involving Trains 4 and 5.

The LNG carriers chartered for the project are Gotaas Larsen's *Golar Spirit* and Lief Hoegh's *Hoegh Gandria.*

Worldwide LNG Developments

The base-load LNG industry's prospects were deliberated at the opening session of the Seventh International Conference on Liquefied Natural Gas held in Jakarta, Indonesia in May. The 1800 delegates heard industry prospects delivered in the opening session, "LNG and World Wide Energy Supplies," at the first workshop session, "Prospects for Expanded LNG Trade," and by some of the keynote speakers. Malcom Peebles succintly summarized the growth prospects for world LNG trade in his opening session paper when he revealed that his current "high" estimate for trade growth equals his "low" estimate of just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3 years ago. The question was properly raised as to whether this is a reflection of the world's current economic malaise or perhaps more fundamental changes in gas markets.

For Europe, a modest increase in demand for natural gas can be seen if the price of imported gas supplies maintains a competitive position. An increase in demand coupled with potential shortages in supply in the 1990's could lead to opportunities for both pipeline and LNG projects. Whether LNG projects can fulfill the gap will depend on the trading terms reached between exporter and importer. The long-held opposing views between exporter and importer as to how gas pricing mechanisms should be structured, unfortunately, remain and were again voiced at the conference.

It was most interesting to hear Japanese buyers, for the first time, state that their market, by far the largest of the three, has undergone fundamental changes. Peebles also identified this change. The Japanese LNG market is dominated by its use in electric power generation and the change is being felt there. Although it might appear to have been more appropriate to have this subject addressed by speakers from the Japanese electric power industry, it was given a most capable treatment by speakers from Japan's gas utility industry. The decline in industrial power demand due in part to collapse of materials industries, which are large consumers, has led to a situation in which a surplus generating capacity is forecast to exist. This condition, which had not existed previously, will result in increased competition among fuels used in power generation. For a number of reasons, LNG ranks below nuclear and coal competitiveness and is only marginally superior to oil. According to the Japanese speakers, for LNG to regain a competitive position, its price must be reduced and its flexibility in terms of take-or-pay quantities — especially in the buildup period — must be enhanced. To do so will require changes in traditional trading terms. If not realized, development of new projects will be confined to those that replace the ones whose term and available gas reserves have been exhausted or to incremental additions for existing projects, which reflects the minimal growth in Japanese demand and new markets in Asia.

The United States does not appear ready to support any new LNG project development until such time as long-term supply contracts again become attractive on the political and regulatory scene.

As a consequence, it appears that growth in world LNG trade beyond those projects that are more or less rigidly defined and accepted as ultimately being realizable, such as Australia and Dome's Western LNG, is likely to be characterized by small-sized projects with phased development. This may be coupled with a trend toward lowest possible capital costs rather than energy efficieny.

To implement these prospective projects will require that certain actions be taken in the near term even though near-term prospects are bleak. Postponement to the time when a more favorable world economic climate may exist could incur risks of losing a viable business opportunity as suppliers of competitive fuels are unlikely to defer until partners in an LNG project reach agreement on a project structure. Such agreement is critical to the financial community that is perceived as becoming more conservative in its view of LNG projects and to governmental officials with commercial, policy, and regulatory responsibilities.

The positive notes are that 1) when taken on balance, the longer-term view of world trade shows the positive factors outweigh the negative, 2) LNG can be delivered at costs which are competitive with other fuels and at prices even below those for high cost gas supplies, 3) there does appear to be a tacit understanding developing between some sellers and buyers that accommodations will need to be reached so that development of new projects may occur in this century, and 4) other means for moving gas in international trade, such as methanol, have not gained a competitive edge. **P&GJ**

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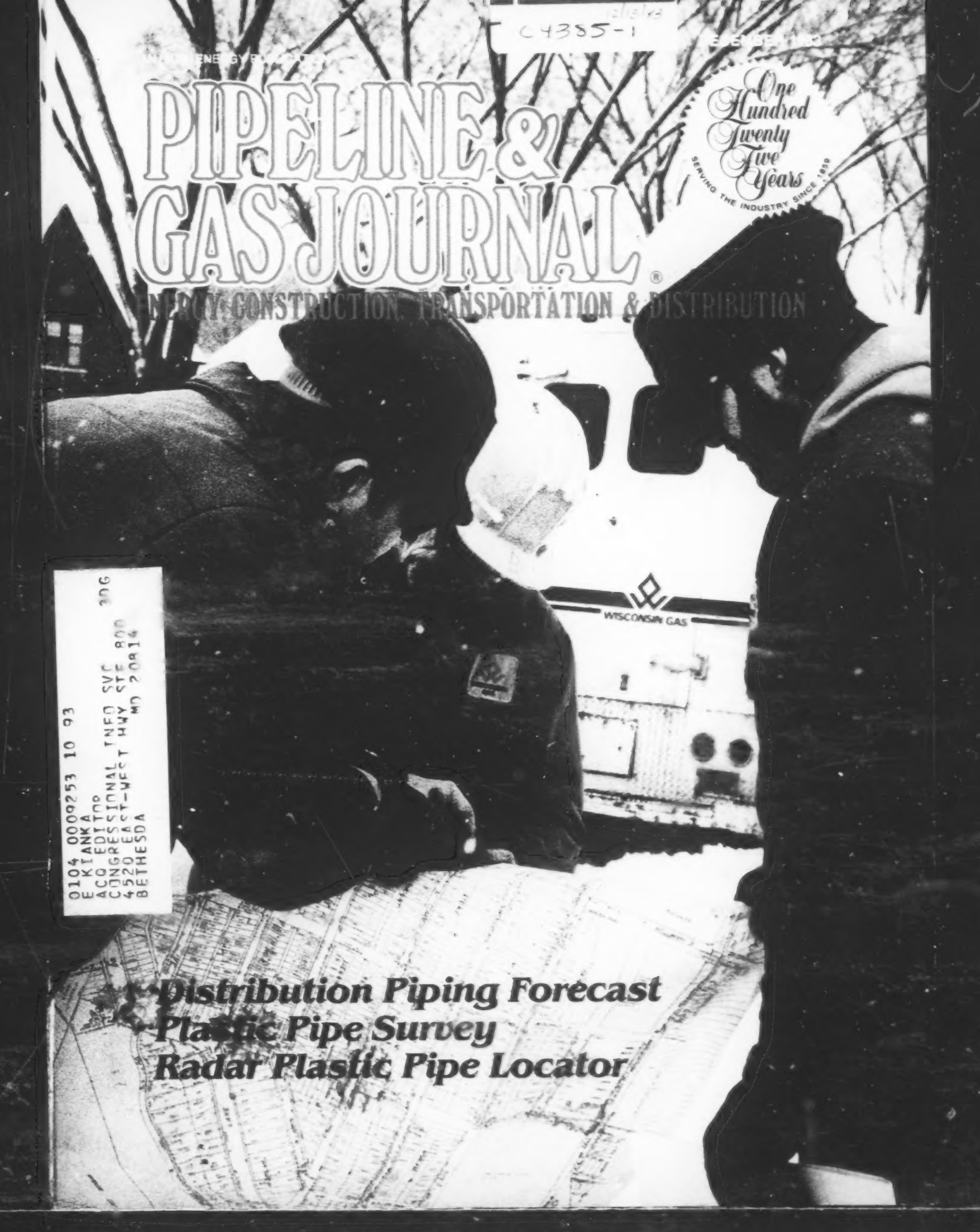

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